

In the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application. Claim 1-19 were withdrawn previously. Claims 24-26, 29, 37-39 and 42 are cancelled by this amendment. Claim 20, 23, 27, 28, 30, 33, 36, 40, 41, and 43, are amended.

1-19 (withdrawn)

20. (currently amended) A method of pose estimation using a primary region representing a circular main fiducial and a secondary region representing an auxiliary fiducial, the method comprising:

locating the primary region;

calculating a plurality of moments of the primary region;

characterizing the primary region as an ellipse based on the moments of the primary region;

calculating a plurality of parameters for a 5D pose based on the ellipse; and

calculating a 6D pose using the 5D pose and the auxiliary fiducial.

21. (original) The method of Claim 20, wherein the calculating a 6D pose using the 5D pose and the auxiliary fiducial comprises calculating a centroid of the auxiliary fiducial.

22. (original) The method of Claim 20, wherein the calculating a 6D pose using the 5D pose and the auxiliary fiducial comprises calculating the orientation of the auxiliary fiducial.

23. (currently amended) A method of pose estimation for a plurality of regions based on a multiple fiducial pattern having a grid of main fiducials, the method comprising:

calculating a plurality of parameters for one or more 5D poses of each region to generate a plurality of 5D ~~poses~~, poses by

calculating a pose normal for each 5D pose; and

calculating a pose center for each 5D pose;

grouping the 5D poses into one or more planar ~~groups~~; and groups by

creating a set of planar groups wherein each planar group has a plane normal and a plane point; and

assigning each 5D pose to a planar group based on the pose normal, the plane normal, the pose center and the plane point;

selecting the planar group with the most members as the plane of the multiple fiducial ~~pattern~~, pattern and adding a new planar group to the set of planar groups when a current 5D pose does not fit any planar group of the set of planar groups.

24. (cancelled)

25. (cancelled)

26. (cancelled)

27. (currently amended) The method of Claim 26, 23, wherein the plane normal of the new planar group is set equal to the pose normal of the current 5D pose.

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28. (currently amended) The method of Claim 26, 23 wherein the plane point of the new planar group is set equal to the pose center of the current 5D pose.

29. (cancelled)

30. (currently amended) ~~The method of Claim 29, wherein orienting the multiple fiducial pattern based on a first 5D pose and a second 5D pose with a center distance that most closely equals a grid distance of the multiple fiducial pattern comprises:~~

A method of pose estimation for a plurality of regions based on a multiple fiducial pattern having a grid of main fiducials, the method comprising:

calculating a plurality of parameters for one or more 5D poses of each region to generate a plurality of 5D poses;

grouping the 5D poses into one or more planar groups;

selecting the planar group with the most members as the plane of the multiple fiducial pattern;

calculating a center difference between each pair of 5D poses to form a plurality of center differences; and

orienting the multiple fiducial pattern based on the 5D poses with a center distance that most closely equals a grid distance of the multiple fiducial pattern by

assigning the center difference whose length most closely equals a grid distance as a first direction of the multiple fiducial pattern; and

assigning a cross product of the first direction with a plane normal as a second direction of the multiple fiducial pattern.

31. (original) The method of Claim 23, further comprising using identifying features to match one or more regions of the plurality of regions to fiducials in the multiple fiducial pattern.

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32. (original) The method of Claim 31, wherein the identifying features provide orientation information.

33. (currently amended) A system of pose estimation using a primary region representing a circular main fiducial and a secondary region representing an auxiliary fiducial, the system comprising:

means for locating the primary region

means for calculating a plurality of moments of the primary region;

means for characterizing the primary region as an ellipse based on the moments of the primary region;

means for calculating a plurality of parameters for a 5D pose based on the ellipse; and

means for calculating a 6D pose using the 5D pose and the auxiliary fiducial.

34. (original) The system of Claim 33, wherein the means for calculating a 6D pose using the 5D pose and the auxiliary fiducial comprises means for calculating a centroid of the auxiliary fiducial.

35. (original) The system of Claim 33, wherein the means for calculating a 6D pose using the 5D pose and the auxiliary fiducial comprises means for calculating the orientation of the auxiliary fiducial.

36. (currently amended) A system of pose estimation for a plurality of regions based on a multiple fiducial pattern having a grid of main fiducials, the system comprising:

means for calculating a plurality of parameters for one or more 5D poses of each region to generate a plurality of 5D poses; poses having:

means for calculating a pose normal for each 5D pose; and

means for calculating a pose center for each 5D pose.

means for grouping the 5D poses into one or more planar groups; and groups having:

means for creating a set of planar groups wherein each planar group has a plane normal and a plane point; and

means for assigning each 5D pose to a planar group based on the pose normal, the plane normal, the pose center and the plane point;

means for selecting the planar group with the most members as the plane of the multiple fiducial pattern. pattern; and

means for adding a new planar group to the set of planar groups when a current 5D pose does not fit any planar group of the set of planar groups.

37. (cancelled)

38. (cancelled)

39. (cancelled)

40. (currently amended) The system of Claim 39, 36, wherein the plane normal of the new planar group is set equal to the pose normal of the current 5D pose.

41. (currently amended) The system of Claim 39, 36, wherein the plane point of the new planar group is set equal to the pose center of the current 5D pose.

42. (cancelled)

43. (currently amended) ~~The system of Claim 42, wherein the means for orienting the multiple fiducial pattern based on a first 5D pose and a second 5D pose with a center distance that most closely equals a grid distance of the multiple fiducial pattern comprises:~~ A system of pose estimation for a plurality of regions based on a multiple fiducial pattern having a grid of main fiducials, the system comprising:

means for calculating a plurality of parameters for one or more 5D poses of each region to generate a plurality of 5D poses;

means for grouping the 5D poses into one or more planar groups;

means for selecting the planar group with the most members as the plane of the multiple fiducial pattern.

means for calculating a center difference between each pair of 5D poses to form a plurality of center differences; and

means for orienting the multiple fiducial pattern based on the 5D poses with a center distance that most closely equals a grid distance of the multiple fiducial pattern having

means for assigning the center difference whose length most closely equals a grid distance as a first direction of the multiple fiducial pattern;
and

means for assigning a cross product of the first direction with a plane normal as a second direction of the multiple fiducial pattern.

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44. (original) The system of Claim 36, further comprising means for using identifying features to match one

or more regions of the plurality of regions to fiducials in the multiple fiducial pattern.

45. (original) The system of Claim 44, wherein the means for identifying features provide orientation information.

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